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ABSTRACT

Writing, editing, and printing texts for schools has been the accepted role of publishers, while text researchers have concentrated on typography, content, and readability. The hundreds of readability formulas now available make readability the most sophisticated of these three areas. Research in reading comprehension suggests that publishers should consider factors other than readability when writing or editing texts, such as reading preferences, incentives, reading interests, and prior knowledge. Text researchers need to develop methodologies which (1) allow readers to study textual materials that are directly relevant to their current goals, (2) allow researchers to study the processing involved in longer text passages, (3) allow researchers to monitor actual studying activities as the readers are processing the text, and (4) allow researchers to assess the influence of various text design features and modifications. One such methodology involves producing booklets with chapters from student texts, some with questions inserted in the text, some without. The reading materials are placed on a platform with a mirror that reflects eye movements of the reader into a videotape camera placed above the reader's shoulder. Despite limitations, this methodology may be helpful to both text researchers and publishers. (HTH)

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Text Research and Publishing Helping Each Other

Student Behavior While Reading from Text

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This paper has two separate but related parts. Briefly, it considers ways in which text research and publishing can help each other in:

1. preparing the text for readers, and
2. observing the readers of the text.

Preparing the Text for Readers

Preparing the text has been the accepted role of publishers, whether they:

- take the text from writers and convert it to print; or
- edit the text from writers to conform to publishing plans; or
- write the text, edit it, and print it.

Text research workers, on the other hand, have concentrated on work in three aspects of text preparation:

- typography, especially legibility of print;
- content of the text, especially curriculum planning;
- difficulty of the text, or readability of the style of writing.

A good deal of research has been, and is still being, done on typography. In the area of legibility, two books stand out, Tinker's Legibility of Print (1963), and Watts and Nisbet's Legibility in Children's Books (1974). This should not imply that all the answers are in. As critics have pointed out, there are so many complex sets of interacting variables that all possible combinations could not be investigated in several lifetimes. But there are no outstanding arguments about what publishers are doing, either.

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The content of texts, or curriculum, is of course a matter of continuing argument. The area is too big and too diverse to comment on here.

The third area, difficulty of the text, or readability, is another matter. Statistically, it is the most sophisticated area of the three, with hundreds of readability formulas now available. In addition, there is a convenient metric: grade level. This makes it possible to look for matches--or mismatches--between the grade placement of readers and the readability grade levels of texts. As a consequence, readability formulas are now widely applied in the field of education. Numerous journal articles cover the analysis of texts, and most have pointed to the finding that texts are too difficult for the readers they were intended for. Teachers and textbook selection committees have, more and more, requested particular grade levels in the texts they choose. And publishers, for their part, now provide readability information (of sorts) for many texts from grade 1 to college level.

Readability concerns have also begun to reach widely into other areas of public life, notably the military services, mass communication, and public documents. Former president Jimmy Carter issued an executive order in 1978 requesting that U.S. regulations be "as simple and clear as possible." About the same time, the State of New York passed a comprehensive "plain English" law which triggered similar bills in other states. By November, 1980, five states had passed such laws and language simplification bills were pending in many others.

Why the spurt of interest in readability? There are at least two major reasons. The first is the growing amount which must be read to succeed--or even survive--in modern society. A recent study estimated that Americans will spend over 1¼ billion hours in 1981 filling out 5,000 different kinds of U.S. Government forms. The growth in amount of written material over the last 70 years can be seen even more dramatically in the field of aviation. What

purports to be the first-known airplane flight manual, that for the Curtiss "pusher" of 1911, was barely one page long. By contrast, the U.S. Navy's Cougar aircraft of 1952 required 1,800 pages of documentation, and a modern F-14 requires 260,000 pages.

The second reason for the growing emphasis on readability is an educational one: the decline in reading skills of high school graduates over the last decade or more. College admission tests, military placement tests, and annual evaluation tests in the schools all point in the same direction. Various reasons have been proposed for this decrease in reading skills, but no one is quite sure what has caused it.

The pincer-like effect of higher reading demands and lower reading skills has become a growing problem. And a proposed cure has been to provide more readable materials. Ironically, readable materials are now being considered a possible cause of the problem as well.

There have been critics of simplified materials, such as rewritten classics, for many years. Recently, however, the criticisms of readability have come from within the educational establishment as well and have been more serious. Maxwell (1978) has wondered if we have "gone too far" with readability. She has suggested that an obsession with it may even be an important factor in the decline of inferential skills of teen-agers in the period of 1970-1974. Chall (1979) has, in fact, reported that a study in her laboratory at Harvard found the current decline in SAT scores to be associated with a decline in the difficulty of textbooks over a thirty-year period. This may seem especially ironic, since she is the co-developer of one of the most widely used readability formulas.

Chall (1979) also reports that publishers say teachers of the elementary grades request science and social studies textbooks two years below the grade

placement of their children. This "reverse mismatch," if not excusable, is at least understandable; as Jorgenson (1977) found, classroom behavior can improve as reading material becomes easier. But Chall also reports that adopting more difficult texts in primary schools has led to an increase in reading scores. Laboratory studies point in the same direction in showing that the difficulty of introductory passages affects performance on following passages. Higher performance has been found for both comprehension (Klare, Mabry, and Gustafson, 1955) and inspection rate (Rothkopf and Coatney, 1974) when the preceding text is harder than when it is easier.

What is the poor publisher to do in the face of this catch-22? Teachers want easier material, but harder material is needed for learning. Perhaps, once again, text research workers and publishers can help each other.

Whether readability measures are good news or bad news depends at least partly on making two successive distinctions before applying them:

- how they are used; and
- why they are used.

Attention to these two distinctions can help to answer the question of usefulness and perhaps also help to resolve the publishers' dilemma.

First, how they are used. Basically, potential users ask two questions of readability research, called respectively the "prediction" question and the "production" question by Klare (1976).

1. How can I tell if readers will find this piece of writing readable (or comprehensible)?
2. How can I change this piece of writing to make it more readable (or comprehensible)?

Formulas use only "index" variables, most often a simple index of semantic or word difficulty and a simple index of syntactic or sentence difficulty. They

are suitable only for answering the prediction question. They do not do this perfectly, but do stack up surprisingly well compared to other kinds of psycho-educational prediction, such as prediction of school grades or success on the job.

Formulas are not, on the other hand, useful for production, as writing guides. "Writing to formula" has always been "verboten," since to make proper changes in comprehensibility requires use of "causal" variables--those which can be shown experimentally to affect comprehension. There are many such variables, far more than the two simple indices just mentioned. Yet the feeling persists that many writers nevertheless do "write to formulas," and the finger has often been pointed at editorial writers in publishing houses. They must resort to this, it is felt, because of the demands of textbook selectors and the pressures of their bosses.

The evidence for this "writing to formula" is scarce, but a recent study appears to supply some. Davison, Kantor, Hannah, Hermon, Lutz, and Salzillo (1980) compared four texts in original versions with adaptations for younger readers. Many changes made by editors in trying to fit the specifications of readability formulas, they suggest, actually made the materials less rather than more comprehensible. They also noted that length and time limits imposed on the rewriters heightened these problems. A follow-up to this study would be helpful, since it suggests that readability formulas may really be mis-used by some publishers.

Most publishers, probably, have no intention of doing this, and yet must face the question, raised earlier, of whether they are playing a part in making material too readable. Here, the second distinction--why formulas are used--becomes relevant. Once again a basic dichotomy may be of help: that

between training readers vs. informing or entertaining them. Training, if our instincts and Chall's research are correct, calls for more challenging material than informing or, especially, entertaining readers.

But how can publishers escape the catch-22 posed earlier by the requests for easier materials? One possible avenue of escape is through research on other characteristics besides word and sentence variables which can affect comprehension. Basically, such research can provide ways to help readers comprehend the more challenging materials that training requires. Here are some relevant findings from studies at Ohio University over the last few years.

- Reading preferences. Denbow (1973) showed that an easier level of readability contributed to the comprehension of both preferred and non-preferred passages, but contributed less--i.e., was less necessary--for the preferred passage.
- Incentives. Fass and Schumacher (1978) found that adding a monetary incentive brought a less readable version of a passage up to the level of comprehension of a more readable version of the passage.
- Reading interests. Entin (1980) surveyed college freshmen's reading interests and showed that, for a series of passages at the same readability level, those at a higher interest level were comprehended better than those at a lower interest level.
- Prior knowledge. Entin and Klare (1978) found that degree of prior knowledge affected the relationship between readability scores and multiple-choice comprehension scores on passages. Entin found a similar trend for cloze scores in the study above (1980).

More research is needed, since the question of comprehension is complex indeed; at this stage, however, the results are encouraging. They suggest that reading material might be made more challenging, and thus better fitted

for training, if it takes into account readers':

- preferences;
- reading interests;
- prior knowledge; and
- love of incentives.

Not startling information, perhaps, but a further way in which text research and publishing might be able to help each other.

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Observing the Readers of the Text

There is an intriguing puzzle surrounding the interaction between text researchers and text publishers. Text researchers have investigated numerous variables which may influence how readers comprehend prose passages. Our own work, for example, has involved several of these variables including text organization (Gardner and Schumacher, 1977), advance organizers (Schumacher, Liebert and Fass, 1975), schema manipulation (Fass and Schumacher, in press) and orienting tasks (Arkes, Schumacher and Gardner, 1976). Other text researchers have investigated these and many more. In fact, it is easy to claim that text researchers have been very inventive in finding new variables to explore.

With this situation in mind it is interesting and instructive to imagine discussing the designing of a textbook with editors and text designers. One might expect such individuals to mention how postquestions or advance organizers were included in a text because the research literature indicates they may aid student learning. Unfortunately, that rarely occurs. One is more likely to find that the editors rely on other sources of information to help them make design decisions. Such sources may include questionnaire data on student or instructor likes and dislikes, sales personnel feedback on text features which are appealing and, probably most importantly, tacit know-how of text designers and typographers.

Why doesn't the empirical work play an important role in text design? We may posit several responses including:

1) the work has not been around long enough to have had a significant impact;
2) text publishers don't read the empirical literature;
3) improper or inappropriate variables have been considered in the text research work;

4) the outcome of the work has not been clear;

5) the work has been done under settings and with materials that won't generalize to textbook usage;

6) the results have not generalized to other situations which appear similar.

While the first two of these reasons suggest text research may soon have significant impact on text design, the latter reasons indicate that may not be the case.

These latter reasons imply that the data base available from text research to aid in document design is not as strong as it could or needs to be. Indeed, an analysis of many of the prose investigations indicates some restrictions that limit the generalizability of that work. Specifically, the work has been conducted 1) on relatively short passages which are unrelated to the subjects' own reading goals, 2) in experimental settings which may alter normal processing activities and 3) with procedures which make it difficult to ascertain the actual studying processes that subjects employ. Such restrictions may be partially responsible for the lack of impact of this research on document and text design.

It is possible, of course, that text researchers are unconcerned about document and text design and instead are concerned about how it is that readers learn from text. That is, they are interested in the nature of the cognitive mechanisms that are used in processing prose material and not how to design texts. We intend no criticism of this orientation because it certainly is important to understand what mechanisms and procedures the human uses in processing prose materials.

But even if the concern is with cognitive processes and not design, researchers are limited in their ability to generalize because of the restrictions noted above. That is, these restrictions may make generalizations to how students comprehend and learn from long text passages inaccurate and even misleading. Certainly the vast work on the role of context by cognitive psychologists such as Bransford and Palmer indicates that comprehension and perception depend extensively on context. Bransford, for example, has demonstrated that the meaning of a passage depends on the contextual setting in which it is located (Bransford and Johnson, 1973). Palmer (1975) has shown that the same visual features are differentially perceived depending on their contextual surroundings.

These findings suggest that the restrictions under which much current prose research is conducted may lead us to inaccurate conclusions regarding which text design modifications are effective in textbooks read under classroom conditions. Similarly we may be reaching inaccurate conclusions about the type of processing activities which students find useful in these same situations. For example, two studies of our own suggest that this may be the case for a variable like readability. Fass and Schumacher (1978) found that a change in subjects' motivational state may make readability appear unimportant in a laboratory setting. Klare and Smart (1973), however, found in a more natural setting that readability can have a dramatic effect on completion of a correspondence course.

If the above argument is accepted, it becomes apparent that we need to develop methodologies which allow researchers to offset some of the existing restrictions on prose research. In particular, prose researchers may need to develop methodologies which allow 1) readers to study textual materials that

are directly relevant to their current goals, 2) researchers to study the processing involved in longer text passages, and 3) researchers to monitor actual studying activities as the readers are processing the texts. Such methodologies would allow researchers to determine the influence of various text design features on actual studying behavior and consequently provide useful information to those individuals interested in assessing the impact of text design modifications. These methodologies could also aid cognitive psychologists interested in cognitive activities employed in natural processing situations.

In the remainder of this presentation we would like to describe one such methodology which we are currently using in a series of studies. There are two key aspects to the methodology - one involves the nature of the stimulus materials and their relation to the reader and the other involves an apparatus for monitoring student studying behaviors. We need to consider each of these in some detail.

In order to increase the liklihood that students will use similar studying behaviors in our experiments as they would use in studying for their own classes we've developed a procedure which allows students to study their own class texts with us. In particular, text selections for the studies are drawn from a chapter which students will be coming to before their next course examination. For example, in one study reported at another session in this convention the stimulus material was the first 3200 words of a chapter in attitudes that the students would be covering before their next examination. In another study involving fifth grade children we've used a passage covering an important event in the revolutionary war - a topic which was being covered by the classroom teacher.

The materials for the studies are reproduced in booklets (usually 10 to 25 pages in length). The booklets are made to appear as much like the texts as our limited production capabilities allow. (This is a point where text publishers could be of real help in this work.) Although we've had to use regularly typed pages (instead of actual type setting), we've included all photographs, figures and small boxes included in the texts. In addition, we've used right justified pages and we've produced the booklets in book form with text on both sides of each page.

In the studies we've done thus far we've kept the actual content of the chapters identical with the students' classroom texts except for variations in text design features. In the three studies which have been carried out or are under way we've been concerned with the role of inserted questions - a mathemagenic variable which has been extensively investigated by Frase (1970) and Rothkopf (1970). Consequently we've produced different versions of the text, some with inserted questions and some without. The procedure to this point has been to insert questions at heading breaks in the texts after the relevant material has been presented. The questions are inserted under headings stating, "A Question to Help You Learn". In our adult studies we've used brief, open-ended questions such as "Why has the concept of attitudes been criticized by some psychologists?"

The procedure described above could of course use many other text design features such as headings, side captions, interior summaries, typographical variables and even text organization. For example, we've tentatively discussed a study with Rob Waller at the Open University in England looking at heading types.

In our adult studies we've had students come in at various times in their studying of these textbook materials. In one study we asked students not to

read the chapter in their text before they participated in the study. In another study we asked them to come and prepare for their final exam with us. In each of the above cases we've told the subjects that the material in the booklet was the same as was in their text, that they had as much time as they wanted to read the material, that they should study as they normally do, that they could underline or take notes if they preferred, that they could pick up and keep the materials after a couple of days if they desired and that they would take a multiple choice exam composed of items similar to their classroom exam after they finished their reading.

In summary, the methodology tries to create a situation in which students can be doing reading and studying activities directly related to their current educational goals.

The second major aspect of the methodology involves the apparatus used to monitor the students' reading activities. This apparatus includes a specially constructed platform on which the reading materials are placed. Mounted approximately six inches above this platform is a one-way mirror which can be adjusted for angle and placement. With appropriate lighting from the side and top the students are able to read the textual material easily through the one-way mirror. The subjects are also able to underline, take notes or write on the booklet. The subjects are seated so that a reflection of their eyes can be seen in the one-way mirror.

In order to record all reading activities which subjects carry out, a videotape camera is placed above the right shoulder. The camera records both the page on which the subjects are reading and also the location and movement pattern of the eyes. This makes it possible to judge approximately where on the page subjects are looking as well as what activities are engaged in as they

read different versions of the same text. The technique was adopted from a related procedure initially used by Karslake (1940).

Some initial reliability work on the procedure indicates that very good accuracy of judgment can be made to the half page a subject is on. With practice judges should be able to determine where the subject is looking to areas three inches on a side. In the study reported here at AERA judges scored the number of lookbacks that students made at the point of the inserted questions. Reliability on the determination of lookbacks from the videotapes was in the .95 range.

The videotapes may obviously be scored for a number of potentially interesting studying variables. These include lookbacks to prior material, lookforwards to related material, pauses in reading at headings, pattern of picture scanning, determination of the level and pattern of use of side captions, use of photographs and figures, determination of the extent of student underlining or note taking and time on passage.

The procedure described here also has some interesting possibilities for investigations of writing behavior. We currently are conducting some studies in which students are asked to complete various writing tasks with us on the apparatus described above. We then have the subjects view the videotapes with us and have them indicate what cognitive activities are employed at various points in their writing.

Uses and Limitations

The methodology provides one way in which text researchers may obtain information of interest to both text publishers and cognitive psychologists. For example, in one study it has been found that inserted questions do result in modifications of student lookbacks to relevant material even though total time on passage did not vary.

In other investigations we are also using this methodology to monitor different studying strategies during first and later readings of a text and to track developmental changes in reading strategies influenced by text design modifications. In the latter case we are investigating whether text design modifications influence poorer reading children more dramatically than their better reading counterparts. Thus, the methodology may provide information previously unavailable to editors and text designers who are interested in the effect of text design modifications. The methodology also may prove helpful to cognitive psychologists in monitoring student studying practices and strategies and hence allow us to infer cognitive mechanisms used in processing prose materials in everyday settings.

There are limitations to this particular methodology which should be noted. First, the degree of accuracy to which eye movements can be made is limited. Karslake (1940) initially claimed that he could obtain accuracy with a similar procedure to a region 2 inches by 2 inches. Our initial estimates suggest that this is not obtainable. Consequently, fine measures of eye fixations do not appear possible. We do not consider this a major problem for our work because we have not been interested in micro eye-movements but in more global studying strategies influenced by text features such as inserted questions. Raters who have had extended practice may be able to make finer judgments.

The second problem with the methodology involves the time of scoring. In our initial study we were averaging about one and one half hours of scoring per subject per judge. Refinements in our procedure have allowed us to reduce this by about one half. The scoring time varies, of course, depending on the number of different dependent variables that one looks at. Another methodology

developed at the Open University by Peter Whalley may not be so time consuming.

Third, the methodology is labor intensive in producing stimulus materials. Currently our process involves several steps including 1) typing the basic text content onto a computer terminal, 2) creating different text versions with various text design modifications, 3) mounting all photographs, figures and boxes, 4) cutting of electronic stencils and 5) production of the actual reading booklets. Since each set of materials can only be used while that text is used for a class, we must choose passages wisely. The current procedure does not allow us to change type fonts or include italics or bold face. While these are not major problems for our work, they might be for individuals interested in other text design features.

In summary, despite the limitations noted above, the methodology described here is one that text researchers may find helpful in studying student activities while reading from text. It allows researchers to monitor studying processes in settings in which normal classroom materials can be used. It may help bridge the gap between text research and text publishers so that text research may become a more important ingredient in the design of textbooks.

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